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ABSTRACT

The University of Missouri-Columbia School of Medicine is developing an audio-tutorial system with several unique features. A Didactor, a device which provides most of the capabilities of computer-assisted instruction but at a fraction of the cost, is the center of the system. The Didactor is combined with tape recordings and slides to present a learning strategy that incorporates the recognition of student errors and the capability of modifying the program to meet the errors. In addition, the device can present both branching and linear program formats. The associated tape recordings are available in regular or compressed times depending on the needs of the student. The primary limiting factor of this system is the programer's ability to perceive and develop learning strategies. The system is part of a total audio-instructional design that also includes closed-circuit television and sophisticated audiovisual aids. A cost effectiveness study of the entire system remains to be done. (MC)

AUDIO-TUTORIAL INSTRUCTION-AN EXPANDED APPROACH

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The University of Missouri-Columbia School of Medicine is developing an audio-tutorial system with several unique features in addition to the usual elements in such a system. Included in this system are tapes, slides, motion pictures, microfiche, compressed speech facilities, and computer-assisted instruction, a television system as well as numerous printed materials.

Our audio-tutorial system is unlike the model for teaching botany that Dr. Postlethwait developed at Purdue University. However, it does resemble other medical education set-ups by way of its multidisciplinary laboratory. The multidisciplinary laboratory is a facility for first and second year medical students in which students have their own study and laboratory spaces available to them throughout the whold 24-hour day. Instead of students moving to a biochemistry lab or a pathology lab, all the laboratory work is done at the students' own stations with the faculty literally being guests of the students. The Existence of such a facility by its very nature shifts the emphasis from the teacher to the student. It is within this physical and philosophical setting that we have instituted our adaptation of the audio-tutorial system.

The development of this system began with the production of a series of "how to do it" tape-slide sets and expanded into informal discussion tapes with 2 X 2 slides providing the visual content. This type of presentation is gradually replacing a number of formal lectures-a procedure undoubtedly typical of the experience of many users of the audio-tutorial system.

With the identification of the Didactor, a device which provides most of the capabilities of computer-assisted instruction (CAI) but at a small fraction of its cost, the broad adaptive, self-instructional capabilities of CAI became available. Programs for the Didactor, currently in various stages of completion include a four-part program on blood-banking, transfusions and so on, a series of programs in maternal and child nursing, and a program on cardiac arrhythmia. In a field test stage are a series of programs in medical statistics and materials for a beginning course in community health.

The Didactor is capable of remembering student errors and modifying the program according to a learner's responses, of putting a learner under the pressure of time, and of presenting both branching and linear program formats. In addition, it will control in synchronism with the learner's responses to its program both a 2 X 2 slide projector and a tape recorder. This means that full audio and visual capabilities are available for use in an adaptive, branching self-instructional mode.

A short sample of a program in immunohematology is diagrammed in flow chart #1 appended to this paper. The learner enters frame number one by pressing a button on the Didactor according to a previous instruction. This first frame refers the learner to a booklet containing descriptions of clinical cases and instructs him to read case #1. After reading the case, he has three alternative choices indicated as A, B, and C.

If the learner chooses B, the correct answer, the Didactor immediately advances to frame 2 which asks the learner to assess his answer and to make a choice indicating that (A) he based his answer upon his previous knowledge or (B) he made a lucky guess. If the learner decides that he had made a reasonable choice based upon his knowledge, the Didactor advances him to frame 34 for the next topic.

The learner had two other alternatives at frame 1. He could have chosen answer C, which is incorrect, or he could have chosen answer A, "I need more information." Within this program, the wrong answer, C, branches the learner to frame 3 where the learner is given an opportunity to identify his areas of weakness. Similarly, answer A enables him to identify in frame 4 the areas where he needs more information. As shown in the flow chart both frames 3 and 4 lead to the same choices, frames 5, 6, or 7. In this program, frames 5-8-9-10-11 review type ABO blood characteristics, frames 7-33 review type MN blood characteristics, and the long series 6-12 through 33 review both ABO and MN characteristics.

In this short excerpt, one student might advance through frames 1-2-34, a second might follow the branch consisting of 1-3-5-8-9-10-11-34, while another might follow the longest branch 1-3-6-12 through 33. Within this last alternative additional branching could occur at 13, 18, and 27

Flow chart #2 illustrates the application of the Didactor's memory to the review of material presumably learned at some previous time. The program consists of a series of pre-tests on specific concepts, each followed by remedial material and a post-test. In operation, the program tests the learner over a given concept by giving him one or more questions on a pre-test. If the learner makes no errors, he is taken immediately to the pre-test over the next concept. However, if the learner makes an error on any of the pre-test questions, he is then taken through a set of remedial frames and a post-test before he is given the next pre-test.

This schema is the format being used to carry low-scoring freshman students through a lengthy program on the mechanics of English. Because the individual student receives remedial instruction only for concepts on which he makes errors on the pre-tests, each student has a program tailored specifically to his needs.

Flow chart #3 shows the capabilities of the Didactor applied to remedial reading instruction. In the reading rate program, timed paragraphs are presented with the number of words and/or allowed reading time varied to provide numerous reading rates. Timed reading coupled with comprehension tests provide a program of remedial work for increasing reading rate. The reading comprehension program uses printed matter as an adjunct. The learner is directed to leave the Didactor program to do an assigned reading, and then to return to the program for a comprehension test.

These several examples are but a few of the learning strategies that can be applied through the use of the Didactor. Keeping in mind that both slides and tapes can be readily incorporated into the design of the program, it becomes evident that the main limiting factor in the application of this system is the programmer's ability to perceive and develop learning strategies.

A second unique feature of our adaptation of the audio-tutorial system is the use of compressed speech. Students have available both regular tapes and compressed tapes on all tape recordings. This means that for first learning sessions a slowly-paced recording is available which provides ample time for reflection and for study of visual elements. For review purposes, the student may prefer to use the 70% compression tapes which are identical in all respects to the original tapes but require only 70% of the original listening time.

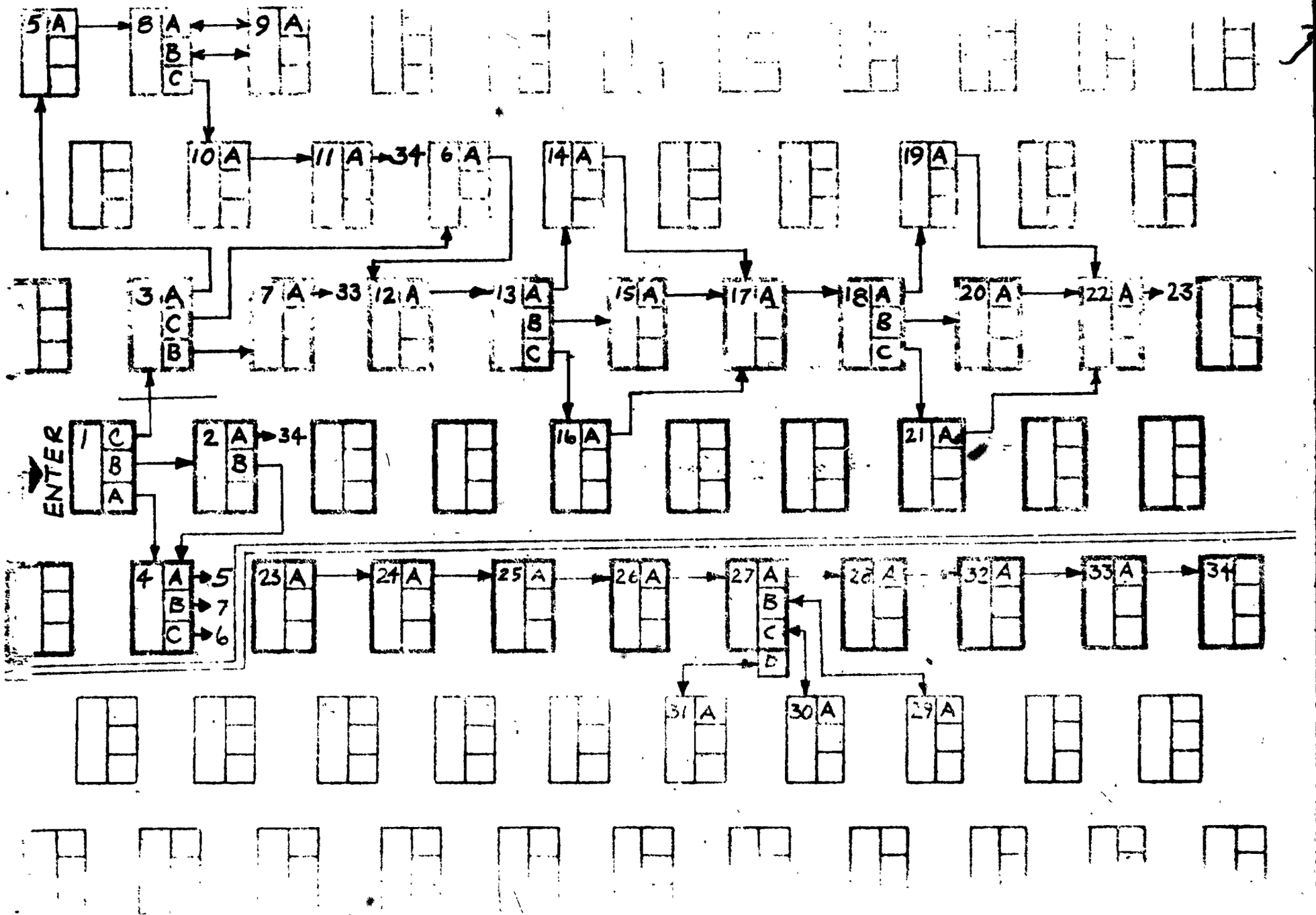
Although we have not had time to investigate further, research to date indicates that compressed speech increases learning. We plan to make available tapes with compression to the 75%, 65% and 60% levels and to thus determine what our students can handle and find suitable. The combination compressed speech and the fast-forward lever on a tape recorder should enable students to "skim" tape recordings much as one skims the printed page.

Because of the highly-selected students in a medical school, we have less concern for a feature inherent in compressed speech than others might have. This feature is the capability for presenting information at rates as high as 350 words a minute. This capability becomes highly interesting when one considers that some students read at rates below 200 words per minute.

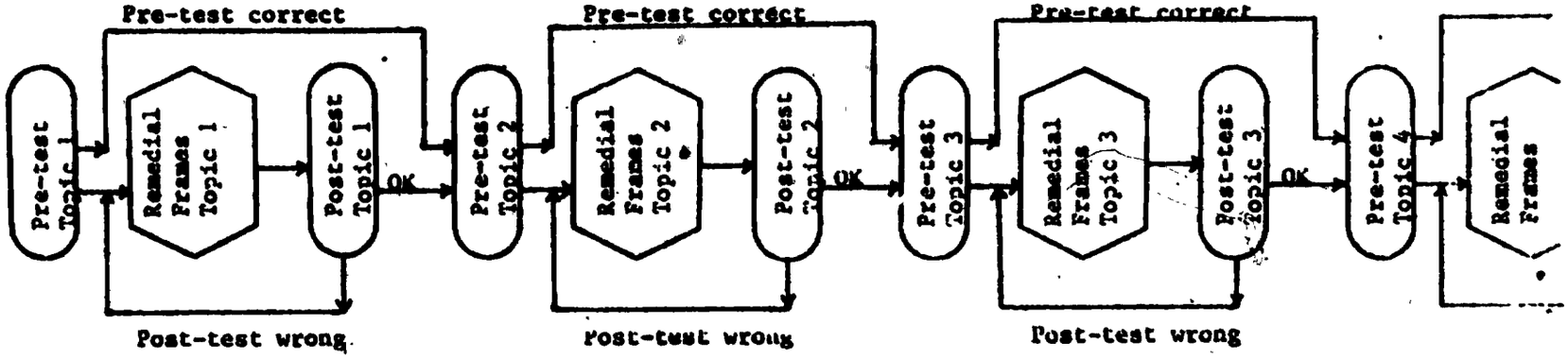
Another component of our audio-tutorial system is a closed circuit television network for viewing videotaped demonstrations and programs. Every two-student station in the Multidisciplinary Lab has just been equipped with a television monitor. The television studio can, then, playback from several recorders any demonstration tapes applicable to the students' studies. Currently a student also has access to regularly scheduled playbacks of the "television journal" produced by the Network for Continuing Medical Education.

In addition to the system components described above, students have access to sound or silent 8 mm and 16 mm motion pictures, microscope slides and microprojectors, microfiche readers and selected references on micorfiche, and miscellaneous printed materials. We have recently acquired a screen-process duplicator and electronic stencil scanner which makes possible the simultaneous production of an overhead transparency and a stencil for high-quality printed materials for use by individual students.

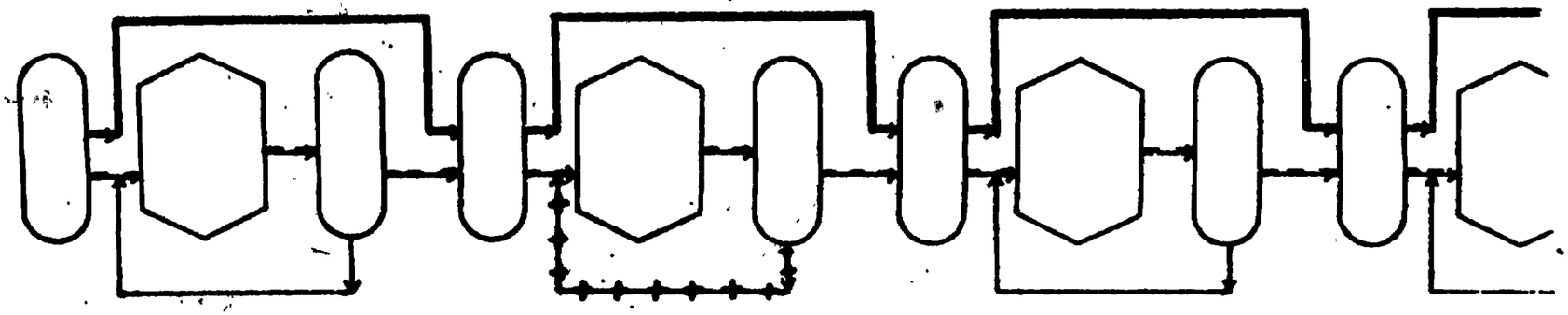
It is too early for us to report on cost effectiveness, but we do know that students have a favorable attitude and that lab instructors report favorably on the results of our "how to do it" programs. In addition there are the intangible yet real benefits such as releasing faculty for the time that the audio-tutorial system can take over the responsibilities for instruction.


ENTER
1 C B A
2 A B → 34
3 A C B
4 A B C → 5, 7, 6
5 A
6 A → 34
7 A → 33
8 A B C
9 A
10 A
11 A → 34
12 A → 13
13 A B C
14 A
15 A → 17
16 A
17 A → 18
18 A B C
19 A
20 A → 22
21 A
22 A → 23
23 A → 24
24 A → 25
25 A → 26
26 A → 27
27 A B C D
28 A → 32
29 A
30 A
31 A
32 A → 33
33 A → 34

PROGRAM FLOW CHART



EXAMPLES OF ALTERNATIVE PATHS

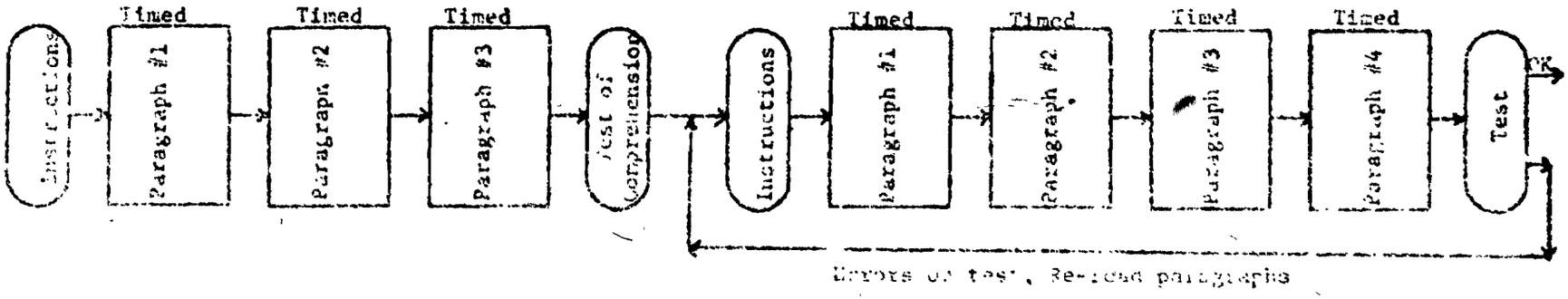


Path of student making no errors

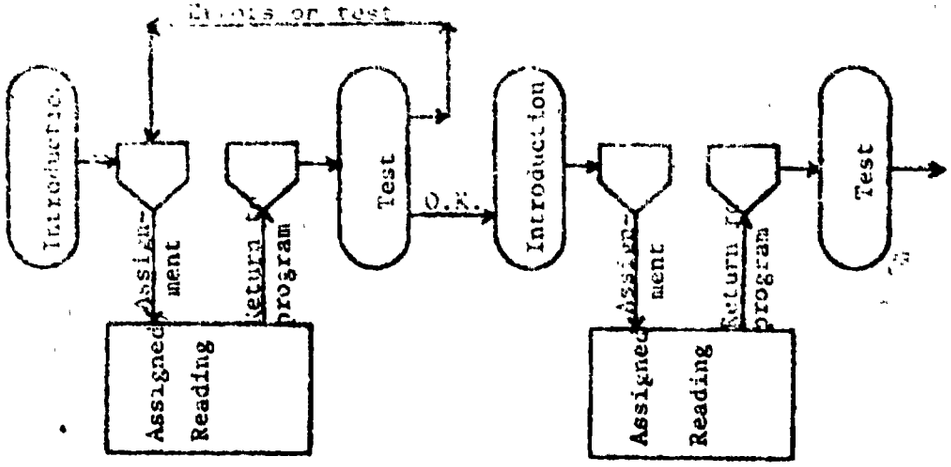
Path of student making errors on pre-tests

Path of student who made an error on the post-test on topic 2

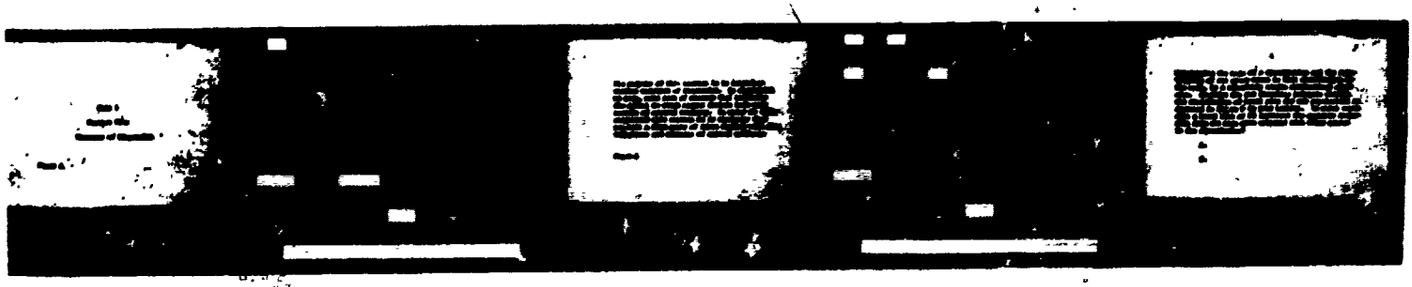
READING RATE PROGRAM



READING COMPREHENSION PROGRAM

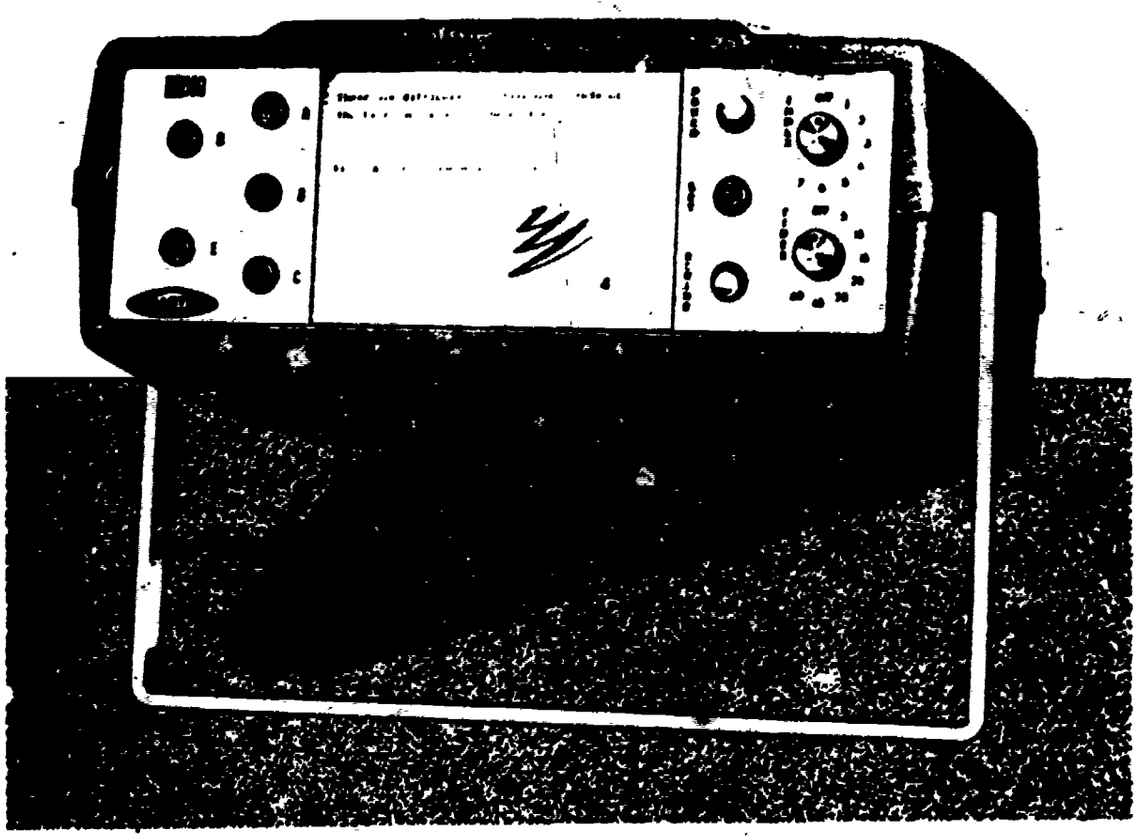


FLOW CHART #3



PROGRAMMED LESSON FILM FOR THE DIDACTOR

Code holes photoelectrically sensed
to program DIDACTOR computer circuits



DIDACTOR, MODEL DTR 300 (Computer Assisted Instruction Unit)